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AUTHOR	Trombley, Carl; And Others
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ABSTRACT

This mathematics curriculum is designed to be taught by the technology education teacher during the power technology class over a period of 2 years. It is intended to be elective in nature; upon successful completion of both years, one-half credit in mathematics is to be awarded. A list of the academic competencies contained in the curriculum cites the chapters in which the competencies are located. Each of the 13 units consists of these components: competencies, lesson, and hands-on or written activity sheet. Unit titles are as follows: orientation and safety, tools of the trade, measuring, preventive maintenance, types of engines, engine disassembly, engine lubrication and cooling, electricity and the battery, charging system, starting system, fuel system, brake systems, and careers. Unit worksheets, unit quizzes, and answer keys are appended. (YLB)

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MATHEMATICS IN POWER TECHNOLOGY

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NAUGATUCK BOARD OF EDUCATION
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NAUGATUCK, CT 06770

PREPARED FOR

CONNECTICUT STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL, TECHNICAL AND ADULT EDUCATION
BUREAU OF VOCATIONAL SERVICES
MIDDLETOWN, CONNECTICUT

MR. CARL TROMBLEY
MR. HARRISON H. BAKER, JR.
MS. COLLEEN PALMER

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POWER TECHNOLOGY
MATHEMATICS COMPONENT

The following curriculum is the result of a joint effort by two instructors from the Naugatuck High School. Ms. Colleen Palmer, representing the Mathematics Department and Mr. Harrison Baker, representing the Technology Education Department. It was felt that a program was needed to help make general mathematics more relevant to high school students and to provide the opportunity for a student to earn academic credit while taking a vocational course. The material will be taught by the Technology Education teacher, during the Power Technology class, over a period of two years. It will be elective in nature and upon successful completion of both years one half credit in mathematics will be awarded. It is hoped that this curriculum will lead to the development of other cross credit activities in different areas.

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The following is a list of the academic competencies contained in this curriculum and the chapters in which they are located.

CONCEPTUAL UNDERSTANDINGS:

	UNIT(S)
1. comparing numbers	2,8
2. fractions, decimals, and ratios	2,6,7,9,10,11,12

COMPUTATIONAL SKILLS:

1. addition and subtraction of whole numbers	1
2. multiplication and division of whole numbers	1,3,4,8,9,11
3. computation with decimals	3,4,7,9,11,12
4. computation with fractions	2,3,4,6,7,9
5. percents	3,5,7

PROBLEM SOLVING:

1. solve process problems	1,4,7,8,9,11,12
2. solve problems involving whole numbers, decimals, fractions and measurement	1,2,3,4,7,8,9,12
3. identify needed information in problem situations	1,4,7,8,9,10,11
4. solve problems involving measurement	1,2,3,
5. solve 1 and 2 step problems involving fractions	2,4,9,
6. interpret graphs, tables and charts	3,4,7,8

MEASUREMENT:

1. Identify figures using geometric terms	1
2. measure and determine perimeters and areas	1
3. estimate lengths, areas, volumes, and angles measurement	1,2
4. make measurement conversions within systems	1,2,4,7

ORIENTATION AND SAFETY

MATH COMPONENT

I. Competency:

The student will compute the perimeter, area and volume of a given space.

A. Determining the Perimeter

B. Determining the Area

C. Determining the Volume

Problem #1

1. Based on State of Connecticut recommendations for classroom size the students will compute the space necessary for their class to be conducted safely.

STATE RECOMMENDATIONS

1. # of students in shop/lab should not exceed 16
2. recommended = 144 square feet per pupil
3. minimum = 120 square feet per pupil

(Net total sq.ft. Recommended 3600 / Minimum 3000)

ORIENTATION AND SAFETY

HANDS ON ACTIVITY

1. Assignment:

   Working in teams of two, measure and record the following information:

   a. Room length = _____ft. _____ in.

   b. Room width = _____ft. _____ in.

   c. Room height = _____ft. _____ in.

2. Using the information above, compute the following:

   a. Room perimeter (distance around)

      Room Perimeter = _____ ft. _____ in.

   b. Area of the room (Area = Length x Width)

      Room Area = _____

   c. Volume of the room (Volume = Length x Width x Height)

      Room Volume = _____

4. Using the data above determine if room size is sufficient for the number of students attending this class. (see State Requirements previous page)

5. Using the data above determine how long it would take a 2500 cubic ft. per minute air purification system to change the air in our room.

6. How many air purification units would be required to change all the air in the room in one-half hour?

TOOLS OF THE TRADE

MATH COMPONENT

I. Competencies:

1. Given the necessary measuring equipment, students will correctly identify the fractional sizes of wrenches and sockets used in the power mechanics lab.

2. Given a list of fractional wrench sizes from 1/4" through 2", the student will arrange them from smallest to largest.

II. Lesson:

1. Each student will be given a ruler, sheet of paper and five wrenches/sockets with their sizes covered. The student will then be instructed how to measure each tool and instructed to record their findings.

2. The student will be instructed on how to find the common denominator of the fractional sizes recorded and then instructed to arrange the wrenches/sockets and fractional sizes recorded in order from smallest to largest.

TOOLS OF THE TRADE

HANDS ON ACTIVITY

I. Assignments:

1. Using the ruler provided measure the tools you were given and record their sizes below.

   1._____ 2. _____ 3. _____ 4. _____ 5. _____

2. Arrange the wrench sizes above from the smallest to the largest.

   1._____ 2. _____ 3. _____ 4. _____ 5. _____

3. Find a common denominator for the following fractional wrench sizes and convert each fraction to the common denominator.

   3/16" 5/8" 1/2" 3/4" 7/8" 7/16" 9/16" 5/32"

4. Arrange the wrenches above from smallest to largest.

5. A mechanic has a combination wrench set (one size per wrench) which contains wrenches from 1/4" to 1" in 1/16" increments. How many wrenches are in this set?

6. While working on a vehicle a mechanic discovers that his/her 1/2" wrench is too small and the 5/8" wrench is too large. Knowing that it's not a metric size what wrench size should he/she try next?

MEASURING

MATH COMPONENT

CUBIC INCH DISPLACEMENT

I. Competency:

1. Given the necessary measurements and formula the student will compute the cubic inch displacement of an engine.

II. Lesson:

1. Students will be instructed in how to compute the cubic inch displacement of an engine using the formula below, and how to round off their answers to the nearest whole number)

Formula: $\frac{\text{Bore}^2 \times \text{Pi} \times \text{Stroke}}{4} \times \text{Number of cylinders} = \text{C.I.D.}$

EXAMPLE:

Bore	Stroke	Number of Cylinders	Answer
4"	5"	6	_____

STEPS:

$\frac{(4" \times 4") \times 3.1416 \times 5"}{4} \times 6 \text{ cylinders} = \text{C.I.D.}$

$\frac{16" \times 3.1416 \times 5"}{4} \times 6 = \text{C.I.D.}$

$\frac{50.2656 \times 5"}{4} \times 6 = \text{C.I.D.}$

$\frac{251.328}{4} \times 6 = \text{C.I.D.}$

$62.832 \times 6 = \text{C.I.D.}$

$376.992 = \text{C.I.D.}$

CUBIC INCH DISPLACEMENT

WORKSHEET

Formula: $\frac{\text{Bore}^2 \times \text{Pi} \times \text{Stroke}}{4} \times \text{Number of cylinders} = \text{C.I.D.}$

Directions

Using the formula above and the measurements below compute the cubic inch displacement of the following engines. Round off your answers to the closest whole number.

	Bore	Stroke	Number of Cylinders	Answer
1.	4"	5"	6	_____
2.	3"	2"	4	_____
3.	6"	4"	8	_____
4.	5"	4"	6	_____
5.	3.5"	4.5"	8	_____
6.	3.75"	5.5"	4	_____
7.	4.25"	4"	6	_____
8.	2.5"	3"	4	_____
9.	4"	3"	4	_____
10.	2"	4"	8	_____

MEASURING

HANDS ON ACTIVITY

Formula: $\frac{\text{Bore}^2 \times \text{Pi} \times \text{Stroke}}{4} \times \text{Number of cylinders} = \text{C.I.D.}$

I. Assignments:

1. Using a ruler and micrometer, measure the bore and stroke of one of the engines in the classroom. Using that information compute its cubic inch displacement.

   a. Engine Number Selected _____

   b. Bore Diameter _____

   c. Length of Stroke _____

   d. Number of Cylinders _____

2. Using the manuals in the room choose a vehicle and record the following information:

   Vehicle Make _____

   Vehicle Model _____

   Name of Manual Used _____

		Information found on Pg.#
a. Engine bore	_____	_____
b. Engine Stroke	_____	_____
c. Number of Cyl.	_____	_____

MEASURING

MATH COMPONENT

COMPRESSION TESTING

I. Competency:

1. Students will accurately interpret compression readings by taking a percentage of a reading and subtracting that number from the reading. (see further information and example below)

COMPRESSION TEST PROCEDURE

When comparing compression test results from various cylinders in an engine, you have to subtract 15% of the highest reading from itself. None of the remaining cylinders should be lower than that reading.

EXAMPLE: A compression test on a four cylinder engine results in the following:

#1 = 195 psi #2 = 180 psi #3 = 175 psi #4 = 185 psi

The highest cylinder is # 1 which reads 195 psi.

15% of this reading is .15 x 195 = 29.25

195 psi - 29.25 psi = 165.75 psi (this is the lowest any other cylinder can be)

The lowest cylinder reading was #3 = 175 psi so this engine is still within specifications.

MEASURING

HANDS ON ACTIVITY

COMPRESSION TESTING

I. Assignment:

Using a vehicle provided (or your own) perform a compression test and record the readings below:

Cylinder Number	Psi
1	_____
2	_____
3	_____
4	_____
5	_____
6	_____
7	_____
8	_____

II. Assignment:

Use the data above and the information you've obtained to determine if this engine is in good mechanical condition.

1. Highest reading = _____

2. Subtract 15% = _____

3. Compare this to lowest reading.

4. Check One _____ Engine Good

_____ Engine Bad

MEASURING

COMPRESSION TESTING

WORKSHEET

Directions

Solve the following problems using the information in your notebooks and a calculator.

During a compression test a mechanic gets the following readings:

#1 = 160 psi #2 = 190 psi #3 = 165 psi #4 = 180 psi

1. What is the lowest acceptable reading for this situation?

   ans. _____

2. What is 15% of the reading on cylinder Number 2 ?

   ans. _____

3. How many more psi would be required to make #1 cylinder acceptable?

   ans. _____

4. How many psi difference is there between the highest and the lowest cylinder above?

   ans. _____

PREVENTIVE MAINTENANCE

MATH COMPONENT

I. Competencies:

1. Student will determine when preventive maintenance is to be performed based on time and mileage requirements.

2. The student will add various capacities together.

II. Lesson:

1. Preventive maintenance must be performed on both a mileage and time basis. Each car manufacturer has its own recommendations.

2. How often an engines oil is changed depends on:

   a. the conditions the vehicle is operated in

   b. how many miles the vehicle has traveled

   c. how long it has been since the last oil change

   EXAMPLE: How many times a year does a driver have to change his/her oil if he/she drives 500 miles each week and changes his/her oil every 3 months or 3000 miles?

500 miles per week
x 52 weeks per year
26,000 miles each year

$$3000\overline{)26000} \quad \underline{8.66666} \text{ times per year based on mileage}$$

change oil every 3 months $\overline{)12}$ months per year $\quad \underline{4}$ times per year based on time

3. Different vehicles require different amounts of oil. Adding whole numbers and fractions is often necessary.

PREVENTIVE MAINTENANCE

HANDS ON ACTIVITY

I. Assignments:

A customer comes in to the garage with a 1989 Ford Mustang with a 5.0 liter High Output engine. The car is operated in very hot, dusty conditions.

Using the manuals in the room, determine the following:

1. How often does the manufacturer say the oil should be changed?

   a. Every _____ months.

   b. Every _____ miles.

   c. Manual used _____ .

   d. Pg. # where you found information _____ .

2. If the manufacturer recommends you change your oil every 3 months or 3000 miles.....

   a. Based on time only, how often should you change your oil each year?

   b. How many times a year should you change your oil if you drive 2000 miles each month?

3. Three cars are in the garage for oil changes. The first car requires 4 1/2 quarts of oil, the second 3 3/4 quarts and the last 5 1/3 quarts. How much oil will you need to complete all three oil changes?

PREVENTIVE MAINTENANCE

WORKSHEET

DIRECTIONS: Complete the following problems using the information in your notebooks and a calculator. Be sure to show the steps you take. For each problem below use 3 months or 3000 miles for your oil change specifications.

1. If ball joints require lubrication every other oil change, how often should they be lubricated?

   a. Every _____ miles

   or

   b. Every _____ months

2. Your records indicate you did an average of two oil changes a day last year. The average oil change produces 4 1/2 quarts of drain oil. Using 365 as the number of days per year, answer the following questions:

   a. How many quarts of drain oil did your garage produce last year?

   b. How many quarts of drain oil did your garage produce each month?

   c. How many quarts of drain oil did your garage produce each week?

   d. How much did it cost to have the oil removed if the waste oil company charged you 28 cents per gallon?

      _____ per week

      _____ per month

      _____ per year

TYPES OF ENGINES

MATH COMPONENT

I. Competencies:

1. The student will compute what percentage each cylinder represents in various sized engines.

2. Given a graphic illustration, the student will calculate the percentage represented.

II. Lesson :

1. Each cylinder in a 8 cylinder engine represents what % of the total engine?

$$8\overline{)100} \quad 12.5\ \%$$

2. Each cylinder in a 6 cylinder engine represents what % of the total engine?

$$6\overline{)100} \quad 16.666\ \%$$

3. 75 % of the cylinders in a 4 cylinder were found to be faulty. How many cylinders were faulty?

$$\begin{array}{r} .75 \\ \times\ 4 \\ \hline 3.00 \end{array} \quad \text{cylinders}$$

4. What % of the engine cylinders below are shaded?

A. B. C.

TYPES OF ENGINES

WORKSHEET

I. Directions: Using your notebook and calculator compute the following percentages.

1. Each cylinder in a 5 cylinder engine represents what % of the total engine?

2. Each cylinder in a 4 cylinder engine represents what % of the total engine?

3. 25 % of the cylinders in an 8 cylinder were found to be faulty. How many cylinders were faulty?

4. What % of the engine cylinders below are shaded?

A.

B.

TYPES OF ENGINES

HANDS-ON ACTIVITY

I. Assignment:

1. Select a vehicle on which to perform a cylinder balance test.

   a. Vehicle Type _____

   b. Number of cylinders _____

   c. What percent of the whole does each cylinder represent?

NOTE: PERFORM THE FOLLOWING ONLY WITH THE TEACHER'S PERMISSION

2. Connect the vehicle above to the diagnostic scope.

3. Choose the cylinder balance test mode and start the vehicle.

4. Electrically "kill" one cylinder and record the % of change.

   Percent of change = _____

5. Compare your answers for # 1.c. and #4. above. Are they the same? Should they be?

ENGINE DISASSEMBLY

MATH COMPONENT

I. Competency:

The student will compute ratios and fractional parts using various engine parts.

Example:

An engine has 8 cam bearings and 4 main bearings. What fractional part of the engines bearings are used for the cam? What fractional part of the engines bearings are used for main bearings?

8 cam bearings + 4 main bearings = 12 engine bearings

a. 8 out of 12 are cam bearings or 8/12 reduced = 2/3

b. 4 out of 12 are main bearings or 4/12 reduced = 1/3

Conclusion: 2/3 of the engines bearings are for the cam and 1/3 for the main bearings.

ENGINE DISASSEMBLY

HANDS ON ACTIVITY

I. COMPUTE THE FOLLOWING FRACTIONAL PARTS

1. While removing the spark plugs from an eight cylinder engine a mechanic found that 3 plugs were carbon-fouled, 5 plugs were oil-fouled and 4 plugs had detonation damage.

In fractional terms answer the following:

1. What fractional part of the engine's plugs was carbon-fouled?

ans. _____

2. What fractional part of the engine's plugs was oil-fouled?

ans. _____

3. What fractional part of the engine's plugs was damaged by detonation?

ans. _____

ENGINE LUBRICATION AND COOLING

MATH COMPONENT

DIRECTIONS: PLACE THE CORRECT ANSWER IN THE SPACE PROVIDED. REFER TO THE ATTACHED CHART FOR ALL INFORMATION.

1. Engine operation is considered to be "clean" above what temperature?

   _____

2. What happens to rings and valves at 60 degrees fahrenheit?

   _____

3. How much cylinder wear was there on the engine that was operated at 160 degrees?

   _____

4. How many gallons of gasoline did the engine operating at 100 degrees use per hour? How much did it use during the entire test?

   _____

   _____

5. How much horsepower did the engine operating at 40 degrees develop?

   _____

6. At what temperature do "oil screens" begin to freeze?

   _____

7. How much cylinder wear was there on the engine that was operated at 40 degrees?

   _____

8. How much horsepower did the engine operating at 160 degrees develop?

   _____

9. How many gallons of gasoline did the engine operating at 40 degrees use per hour? How much did it use during the entire test?

   _____

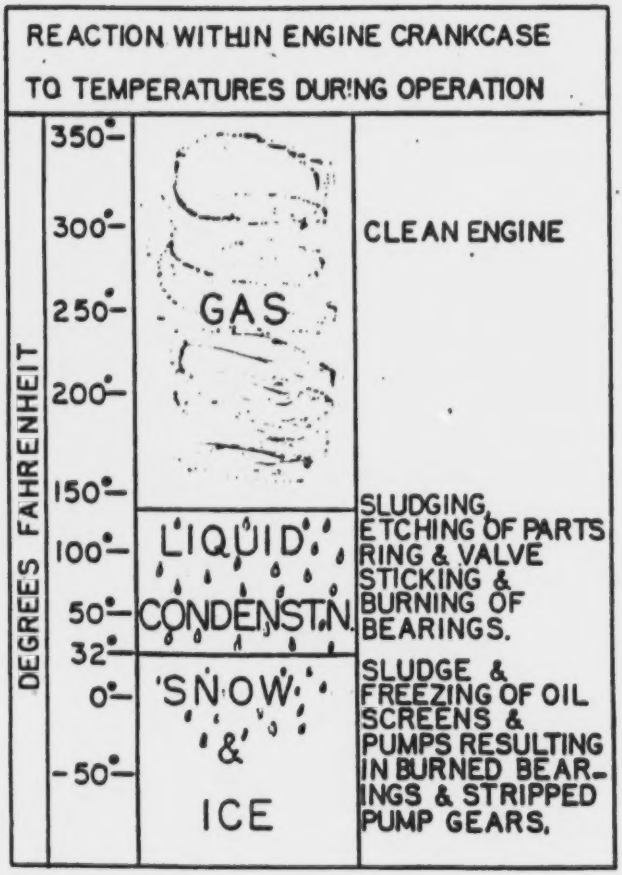
   _____

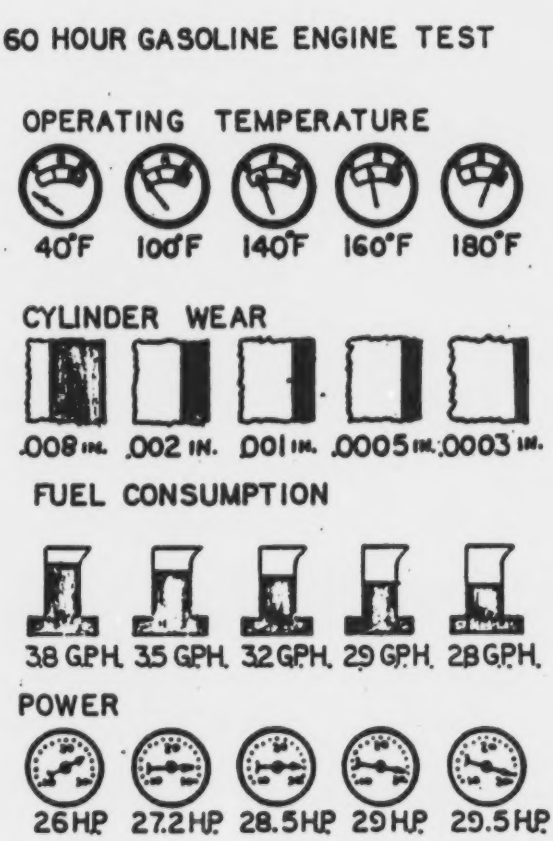
10. At what temperature does the "etching of parts" begin?

    _____

ENGINE LUBRICATION AND COOLING

60 HOUR GASOLINE ENGINE TEST





ENGINE LUBRICATION AND COOLING

MATH COMPONENT

I. Competency:

The student will convert fractions to decimals and vice versa; calculate a percentage; and identify correct points on a graph or line.

Example:

1. If the capacity of a cars cooling system is 21 qts. and 45% of the coolant is antifreeze, how many qts. of antifreeze does the car have in it? How many qts. of water?

21 qts. x 45% = _____ qts. of antifreeze

$$\begin{array}{r} 21 \\ \times .45 \\ \hline 9.45 \text{ qts. of antifreeze} \end{array}$$

21 qts. x 55% = _____ qts. of water

$$\begin{array}{r} 21 \\ \times .55 \\ \hline 11.55 \text{ qts. of water} \end{array}$$

2. The manufacturer recommends a mixture of 50% water and 50% antifreeze. The car you are servicing has a cooling system capacity of 17 qts. How many qts. of antifreeze will you need to refill the system after it has been drained?

50% of 17 qts. = _____ number of quarts required

$$\begin{array}{r} 17 \\ \times .50 \\ \hline 8.5 \text{ qts. of antifreeze} \end{array}$$

3. Using the chart on the antifreeze container, determine the amount of antifreeze needed for a car with a cooling system capacity of 23 qts.

ENGINE LUBRICATION AND COOLING

HANDS ON ACTIVITY

1. Using the manuals in t front of the room look up the following car and calculate the amou of antifreeze you will need after draining and flushing the cooling system.

   1988 Chev. Caprice, 305 cubic inch engine, with air conditioning

   Cooling system capacity = _____ qts.

   Recommended mixture 50 / 50

   Qts. of antifreeze required = _____ qts.

2. A customer enters your garage and asks to have his/her car winterized. You determine that the car has a 19 qt. cooling system. How many qts. of antifreeze will you need to complete the job?

   _____ qts.

3. Looking at the jobs scheduled for the next day you find that you have two cars to be winterized. One car has a 13 qt. capacity and the other a 16 1/2 qt. capacity. How many qts. of antifreeze will be needed to complete both jobs?

   _____ qts.

4. How many gallons would you have to purchase to complete all the jobs on this page?

   _____ gals.

ELECTRICITY AND THE BATTERY

MATH COMPONENT

I. Competency:

The student will solve for the unknown value when given the Ohms' Law formula.

$E = I \times R$ $\quad$ $I = E/R$ $\quad$ $R = E/I$

E = VOLTS (volts) I = CURRENT (amps) R = RESISTANCE (ohms)

1. A mechanic is testing a component on a vehicle that has a 12 volt battery and he/she gets a reading of 6 ohms. How many amps are there in the circuit?

$I = E/R$

2. During a battery draw test a mechanic gets a reading of 100 amps. The starters resistance measures 1200 ohms. What is the battery voltage?

$E = I \times R$

3. An old VW beetle with a 6 volt battery comes into your garage. While testing the wiper motor you get a reading on your ammeter of .05 amps. What is the resistance of this motor?

$R = E/I$

4. How much current will a light bulb with 12K ohms (12,000 ohms) draw when connected to a 36 volt battery?

$I = E/R$

5. How many volts are being applied to a circuit with a reading .004 amps if the resistance is equal to 6K (6000 ohms)?

$E = I \times R$

ELECTRICITY AND THE BATTERY

OHMS LAW

DIRECTIONS: USING THE FOLLOWING FORMULAE SOLVE THE PROBLEMS BELOW. BE SURE TO SHOW ALL WORK AND LABEL YOUR ANSWERS.

$E = I \times R$ $I = E/R$ $R = E/I$

E = VOLTS (volts) I = CURRENT (amps) R = RESISTANCE (ohms)

1. 3 volts .005 amps resistance = _____

2. 6 volts 1200 ohms current = _____

3. 2.5 amps 300 ohms voltage = _____

4. .06 amps 12 volts resistance = _____

5. 2400 ohms 12 volts current = _____

6. I = .002 E = 36 R = ? _____

7. I = ? E = 6 R = 1500 _____

8. I = .08 E = ? R = 1650 _____

9. I = 2 E = .5 R = ? _____

10. I = ? E = 3 R = 900 _____

ELECTRICITY AND THE BATTERY

OHMS LAW

DIRECTIONS: USING THE FOLLOWING FORMULAS SOLVE THE PROBLEMS BELOW. DO NOT WRITE ON THIS TEST. PLACE YOUR ANSWER ON THE SHEET PROVIDED.

$E = I \times R$ $\quad I = E/R$ $\quad R = E/I$

E = VOLTS (volts) I = CURRENT (amps) R = RESISTANCE (ohms)

11. A mechanic is testing a component on a vehicle that has a 12 volt battery and he gets a reading of 3 ohms. How many amps are there in the circuit?

12. During a battery draw test a mechanic gets a reading of 200 amps. The starters resistance measures 2400 ohms. What is the battery voltage?

13. An old VW beetle with a 6 volt battery comes into your garage. While testing the wiper motor you get a reading on your ammeter of .02 amps. What is the resistance of this motor?

14. How much current will a light bulb with 12K ohms (12,000 ohms) draw when connected to a 12 volt battery?

15. How many volts are being applied to a circuit with a reading .003 amps if the resistance is equal to 6K (6000 ohms)?

16. 6 volts .005 amps resistance = _____

17. 4 volts 1200 ohms current = _____

18. 2.5 amps 600 ohms voltage = _____

19. .04 amps 12 volts resistance = _____

20. 1200 ohms 12 volts current = _____

ELECTRICITY AND THE BATTERY

HANDS ON ACTIVITY

OHMS LAW

DIRECTIONS: USING THE EQUIPMENT PROVIDED IN THE FRONT OF THE ROOM MEASURE THE AMOUNT OF CURRENT, VOLTAGE AND RESISTANCE IN EACH OF THE CIRCUITS.

PART I

CIRCUIT # 1

1. AMPS = _____

2. VOLTAGE = _____

CIRCUIT # 2

1. AMPS = _____

2. RESISTANCE = _____

CIRCUIT # 3

1. VOLTAGE = _____

2. RESISTANCE = _____

PART II

DIRECTIONS: USING THE FORMULAE GIVEN BELOW AND THE READINGS YOU OBTAINED ABOVE SOLVE FOR THE UNKNOWN VALUE.

E = I X R I = E/R R = E/I

E = VOLTS (volts) I = CURRENT (amps) R = RESISTANCE (ohms)

CIRCUIT 1 - RESISTANCE = _____

CIRCUIT 2 - VOLTAGE = _____

CIRCUIT 3 - AMPERAGE = _____

THE CHARGING SYSTEM

MATH COMPONENT

I. Competency:

The student will determine the condition of an alternator by multiplying the alternators output by a fraction.

EXAMPLE:

While testing an alternator a mechanic reads the following: "During this test alternator output should not be less than 2/3's of the total rated alternator output."

1. If the alternator rated output is 60 amps. what is the minimum acceptable output?

2. If the alternator rated output is 100 amps. what is the minimum acceptable output?

3. If the alternator rated output is 50 amps. what is the minimum acceptable output?

THE CHARGING SYSTEM

HANDS ON ACTIVITY

DIRECTIONS: USING THE EQUIPMENT PROVIDED MEASURE AND RECORD THE FOLLOWING INFORMATION ABOUT YOUR / TEST VEHICLE.

1. BATTERY VOLTAGE = _____ VOLTS

2. CHARGING AMPERAGE = _____ AMPS

3. CHARGING VOLTAGE = _____ VOLTS

4. STARTER DRAW = _____ AMPS

THE STARTING SYSTEM

MATH COMPONENT

I. Competency:

Given the size of two mechanical components the student will determine their ratio.

EXAMPLE:

There are 200 teeth on an engines flywheel and 10 teeth on the engines starter drive.

What is the ratio between the starter drive and the flywheel?

200 TO 10 or 20 to 1

20:1

How many times must the drive turn in order to turn the flywheel once?

20 times

THE STARTING SYSTEM

HANDS ON ACTIVITY

DIRECTIONS: USING ONE OF THE DEMO ENGINES IN THE ROOM, COMPUTE THE RATIO OF THE STARTER DRIVE AND FLYWHEEL BY COUNTING THE TEETH AND MEASURING THE DIAMETER OF BOTH COMPONENTS.

ENGINE SIZE _____

STARTER TYPE _____

DRIVE DIAMETER _____

TEETH ON DRIVE _____

TEETH ON FLYWHEEL _____

FLYWHEEL DIAMETER _____

RATIO BY DIAMETER = _____

RATIO BY # OF TEETH = _____

THE FUEL SYSTEM:GENERAL

MATH COMPONENT

I. Competencies:

1. Given the necessary information students will:

   a. accurately compute "miles per gallon"

   b. accurately compute necessary fuel requirements for different length trips

   c. accurately compute the cost of travel based on M.P.G., distance traveled and current fuel prices

II. Lesson:

1. How many miles per gallon does a vehicle get if it travels 300 miles on 15 gallons of fuel?

$$\frac{300 \text{ miles}}{15 \text{ gallons}} \qquad 15\overline{)300} = 20 \text{ mpg}$$

2. You are planning a trip across country which will be about 5200 miles. Your car gets 26 miles per gallon.

   a. How much fuel will you need to complete your trip?

$$26\overline{)5200} = 200 \text{ Gallons}$$

   b. How much money will you need for fuel if fuel costs $1.28 per gallon?

$$\begin{array}{r} 200 \text{ gallons} \\ \times\ 1.28 \\ \$256.00 \end{array}$$

THE FUEL SYSTEM:GENERAL

HANDS ON ACTIVITY

I. Assignment:

Within the next three weeks compute the MPG of your family car.

Record the following information:

1. Odometer reading after filling the gas tank completely.

   _____ miles

2. Odometer reading at next fill up, the number of gallons it took to fill the tank, type of gas (regular, unleaded, super) and the price per gallon.

   a. _____ miles

   b. _____ number of gallons to fill tank

   c. _____ type of gasoline

   d. _____ price per gallon

3. Subtract the odometer reading recorded in number 1. from the one you recorded in number 2. and record the number of miles traveled.

   Odometer reading #1. _____
   - Odometer reading #2. _____
   Miles traveled _____

   a. _____ number of miles traveled

4. Divide the number of miles that were traveled by the number of gallons of gasoline it took to fill the tank in #2. Your answer will be the number of miles per gallon your vehicle gets.

$$\frac{\text{miles traveled}}{\#\text{ gallons}}$$

HANDS ON ACTIVITY

THE FUEL SYSTEM:GENERAL

I. Assignment:

Using the map provided:

1. Compute and record the distance, in miles, between your house and the High School.

_____ miles

2. How many miles would you travel if you drove round trip from your house to school every day during the school year? (NOTE: there are 180 school days each year

miles X 2 = miles driven per year to school

_____ miles

3. Based on the information above how many gallons of gas would you require during the school year?

MPG ⟌ # of gallons required / miles traveled

4. How much will it cost you to drive to school each day based on your gas stations current prices?

BRAKE SYSTEMS

MATH COMPONENT

I. Competency:

Given the necessary measuring equipment students will:

1. determine the thickness of a brake rotor and the diameter of a brake drum
2. calculate the amount of material that can be safely removed during a rotor/drum resurfacing operation

II. Lesson:

1. As part of a good brake job, mechanics must be able to resurface brake drums and rotors correctly and safely. A good visual inspection and cleaning followed by accurate measuring is essential.

2. Students will:

   a. measure both a drum and rotor recording the drums diameter and the rotors thickness

      drum dia. _____

      rotor thickness _____

   b. determine the maximum diameter the drum can be using references found in the room

      max. drum dia. _____

   c. using references found in the room determine the minimum thickness the brake rotor may be turned

      min. rotor thick. _____

   d. calculate the maximum amount of material which may be removed from both the drum and the rotor and record below

      rotor _____

      drum _____

BRAKE SYSTEMS

WORKSHEET

Directions: Calculate the following and record your answers.

1. While performing a brake job on a 1969 Chevy Camero a mechanic measures the brake drum and obtains a reading of 9.535". The manual indicates that the drums original diameter was 9.5". The following information is stamped on the brake drum; "MAX. DIA. 9.560". How much material can the mechanic safely remove?

2. A mechanic measures a used brake rotor and finds that it is .997" thick. The manual indicates that the original thickness was 1.00" and that the discard thickness is .960" How much material can be removed from this used rotor? How much material can be removed from a new rotor?

3. A drum measures 11.046" in diameter. This is .046" oversize. If the drum was never resurfaced what was the original drum diameter?

4. A rotor measures .892" thick. Discard thickness is listed as .860". How much material may still be removed?

BRAKE SYSTEMS

HANDS ON ACTIVITY

I. Assignment: Make the following measurements, using the appropriate system (standard or metric), and record your findings in the space provided.

A. Rotor -

1. Select a rotor, measure its thickness and record below.

   a. _____ in./mm thick

2. Determine this rotors original thickness and record below.

   a. _____ in./mm

3. Find this rotors minimum or discard thickness and record below.

   a. _____ in./mm

4. Using the information you recorded above, calculate how much the rotor has worn and how much material may still be removed.

   a. _____ in./mm of wear

   b. _____ in./mm of material remaining

B. Drum -

1. Select a drum and measure its diameter.

   a. _____ in./mm diameter

2. Determine this drums original diameter and record below.

   a. _____ in./mm diameter

3. Calculate the amount this drum is worn.

   a. _____ in./mm of wear

4. Using the information you recorded above, calculate how much material may be safely removed.

   a. _____ in./mm of remaining material

CAREERS

MATH COMPONENT

I. Competency:

With the use of reference materials in the room students will correctly fill out a "work order form" (see attached) including:

1. Owner information

2. description of vehicle, date, mileage....

3. description of work performed, and amount of time necessary to complete the work.

II. Lesson:

All members of the class will complete an estimate using a Work Order Form for the following job:

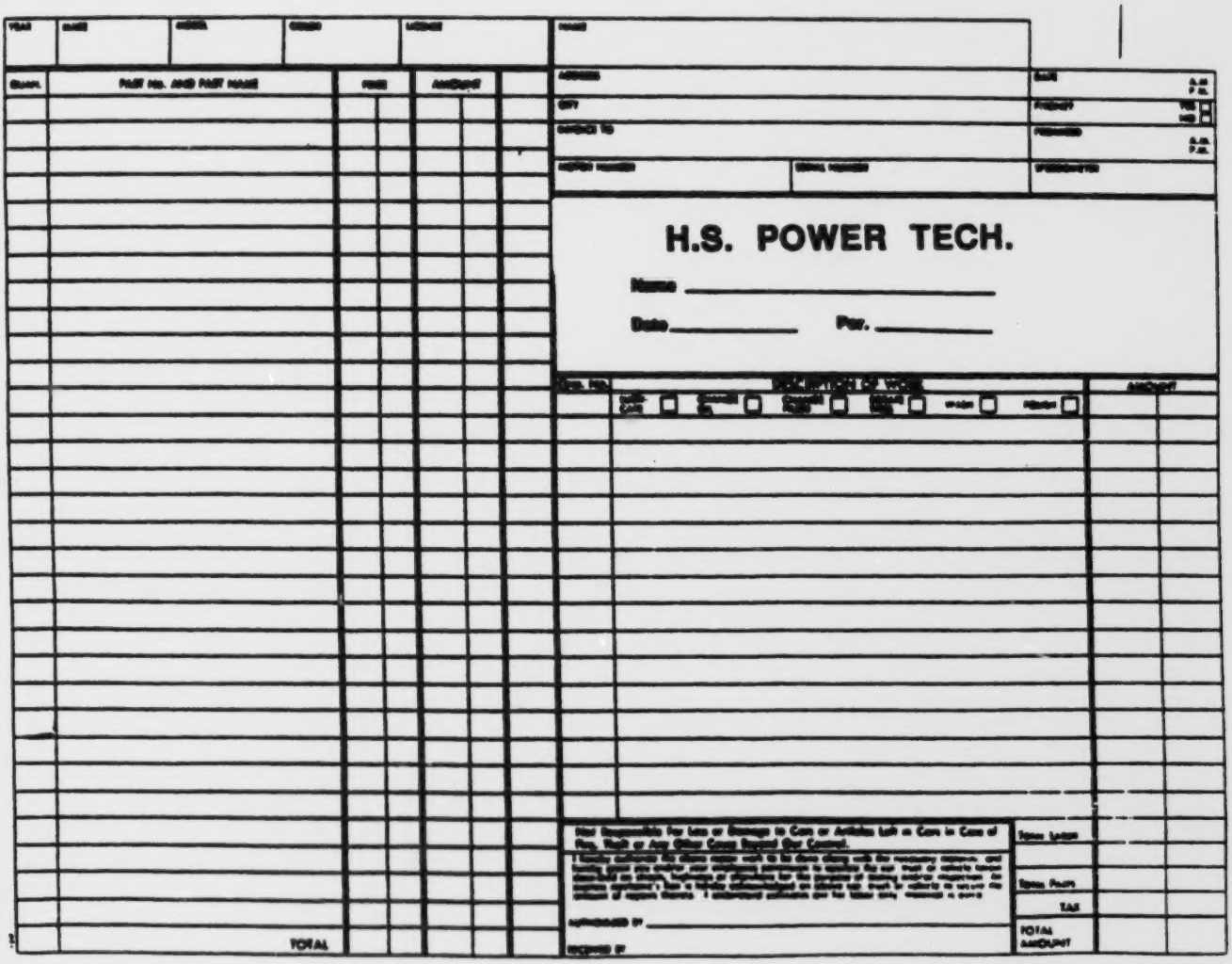
Replace the exhaust system on a 1986 Buick Station Wagon from the catalytic converter back. It has a 350 cu. in. engine, 4 barrel carb. and 2 1/2" tailpipe. Use your name and address where customer information is needed. Be sure to list all pipes, hangers and clamps required. List all prices and the amount of time it will take to perform this job. Finally, compute how much the labor will be using an hourly rate of $33.50/hr. Add both the labor and parts together for the total cost of the repair.

CAREERS

HANDS ON ACTIVITY

I. Assignment:

Complete a work order form for a "major engine tune-up" for your or your family car. Be sure to fill out form completely. Use references in the room to determine necessary parts, hours required etc. Calculate the cost of this operation.



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MATH COMPONENT - POWER TECHNOLOGY QUIZZES AND WORKSHEETS

UNIT 1 WORKSHEET

I. Calculate the following:

1. $\begin{array}{r} 684 \\ 827 \\ +139 \\ \hline \end{array}$

2. $2\,(643 + 524)$

3. $6\,(87) + 3\,(60)$

4. $(64)\,(192)$

5. $\begin{array}{r} 753 \\ \times 281 \\ \hline \end{array}$

6. $(82)\,(95)\,(17)$

CARRY OUT TO 3 DECIMAL PLACES. ROUND OFF TO TWO DECIMAL PLACES.

7. $24\overline{)647}$

8. $159\overline{)3008}$

9. $373\overline{)82194}$

10. Convert the following:

2 ft. 6 inches	=	_____ inches
102 inches	=	_____ ft. _____ inches
6.4 mm	=	_____ cm
1472 cm	=	_____ meters
1 inch	=	_____ cm

UNIT 1 QUIZ

Directions: Calculate the following and place your answer on the paper provided.

1. 6 (86 + 15)

2. (383) (26)

3. (43) (17) (52)

CARRY OUT TO THREE DECIMAL PLACES. ROUND TO TWO DECIMAL PLACES

4. $38\overline{)6671}$

5. Directions: Convert the following and place your answer on the paper provided.

4 ft. 8 inches	=	_____ inches
303 inches	=	_____ ft. _____ inches
62 cm	=	_____ m
10 m	=	_____ cm
1 inch	=	_____ cm

Use the following information for questions # 6 -1 10

A room measures 20' 4 " wide, 22' 6"long and is 10' 2" high.

6. The rooms perimeter = _____

7. The rooms area = _____

8. The rooms volume = _____

9. How many gallons of paint will it take to cover the floor of the room if each gallon of paint covers 100 square feet?

10. How long would it take a 1500 cubic ft. per minute air purification system to change the air in the room?

UNIT 2 WORKSHEET

Directions: Place all your answers in the space provided.

1. Using the ruler provided, measure the length of the following line segment to the nearest 1/16 of an inch.

answer _____

2. Using the ruler draw a line segment that is 2 3/8" long in the space provided.

FOR PROBLEMS # 3 -5, FIND THE COMMON DENOMINATOR AND CONVERT EACH FRACTION TO COMMON DENOMINATOR FORM. ORDER FRACTIONS FROM SMALLEST TO LARGEST IN EACH PROBLEM.

3. 1/2, 1/4, 2/3

   smallest _____ _____ _____ largest

4. 2/5, 2/4, 3/10, 7/20

   smallest _____ _____ _____ _____ largest

5. 5/16, 4/8, 17/32, 1/2, 1/4, 3/16

   smallest _____ _____ _____ _____ _____ largest

COMPUTE PROBLEMS # 6 - 9 BY ADDING THE GIVEN FRACTIONS. REDUCE ALL ANSWERS IF POSSIBLE.

6. 4/12 + 3/12 + 1/12 = _____

7. 1/2 + 1/4 + 1/8 = _____

8. 5/12 + 2/3 + 2/4 = _____

9. 2/20 + 7/15 + 4/10 = _____

10. Name a fraction that is larger than 1/4 and smaller than 7/16.

    answer _____

UNIT 2 QUIZ

Directions: Calculate the following and place your answer on the paper provided.

1. Estimate to the nearest 1/16 of an inch the length of the following line segment.

2. Using a ruler draw a line segment that is 1 7/8" long.

3. Add the following: (reduce if possible)

   3/16 + 2/8 + 1/32 =

4. Add the following: (reduce if possible)

   2/7 + 6/77 + 4/11 =

5. Add the following: (reduce if possible)

   1/4 + 2/5 + 1/6 =

FOR PROBLEMS # 6 - 7 FIND THE COMMON DENOMINATOR AND CONVERT EACH FRACTION TO COMMON DENOMINATOR FORM. ORDER FRACTIONS FROM SMALLEST TO LARGEST IN EACH PROBLEM.

6. 1/16 1/2, 3/8, 14/32 2/4

   smallest _____ _____ _____ largest

7. 2/5, 3/10 4/5, 5/20

   smallest _____ _____ _____ _____ largest

8. A mechanic has a combination wrench set (one size per wrench) which contains wrenches from 1/4" to 2" in 1/4" increments. How many wrenches are there in this set?

9. While working on a vehicle a mechanic discovers that a 3/4" wrench is to small for the job and a 7/8" is too large. Knowing that it's not a metric size what wrench size should he try next?

10. A mechanic needs a 3/8" wrench. He takes three wrenches from the tool box and tries each. Two wrenches are to small and one is too large. The 3 wrenches were labeled 1/4", 1/2" and 5/16" which wrench was too large and which were too small?

    small: _____ , _____ large: _____

UNIT 3 WORKSHEET

Directions: Compute the following problems. Place all your answers in the space provided.

MULTIPLY:

1. $\begin{array}{r} 2.8 \\ \times .63 \\ \hline \end{array}$

2. $\begin{array}{r} 64.9 \\ \times .035 \\ \hline \end{array}$

3. (14.6) (29.8)

4. (8.2) (4.6) (.613)

5. (23.6) (10.4) (8)

DIVIDE: CARRY OUT TO THREE DECIMAL PLACES AND ROUND TO TWO

6. $6\overline{)824.6}$

7. $4\overline{)28.04}$

ROUND TO THE NEAREST WHOLE NUMBERS:

8. 62.019 _____

9. Find 28% of 82 _____

10. Find 83% of 104 _____

UNIT 3 QUIZ

Directions: Calculate the following problems and place your answers on the paper provided.

MULTIPLY

1. 46.2
   90.5

2. (63.6) (1.83)

DIVIDE

3. $7\overline{)82.06}$

ROUND TO THE NEAREST WHOLE NUMBER

4. 6.496 _____

5. Find 42% of 16 _____

USE THE FOLLOWING INFORMATION FOR #6-9. DURING A COMPRESSION TEST A MECHANIC GETS THE FOLLOWING READINGS:

Cylinder #1 = 150 psi Cylinder #2 = 185 psi
Cylinder #3 = 165 psi Cylinder #4 = 175 psi

6. What is the lowest acceptable reading for this situation?

   _____

7. What is 15% of the reading on cylinder #2?

   _____

8. How many more psi would be required to make #1 cylinder acceptable?

   _____

9. If the highest reading were 165 psi, would cylinder #1 be acceptable? (Show your work.)

USE THE FOLLOWING FORMULA TO CALCULATE THE PROBLEMS BELOW.

$$\frac{BORE^2 \times PI \times STROKE}{4} \times \text{NUMBER OF CYLINDERS} = C.I.D.$$

10.	BORE	STROKE	# of CYL.	ANS.
a.	3"	3.5"	6	_____
b.	4..25"	4.5"	8	_____

UNIT 4 WORKSHEET

Directions: Compute the following problems. Place all your answers in the space provided.

ADD:

1. 2 1/2
   +6 1/3

2. 3 3/4
   +2 1/8

MAKE THE FOLLOWING CONVERSIONS

3. a. 4 gallons = _____ quarts

   b. 18 quarts = _____ gallons _____ quarts

   c. 1 year = _____ days

   d. 1 year = _____ weeks

   e. 1 year = _____ months

MULTIPLY

4. 3 1/2 x 3 = _____

5. 4 x 5 3/7 = _____

ADD: (simplify improper fractions)

6. 2 + 3 1/3 = _____

7. 6 + 2 1/2 = _____

8. 2 3/4 + 3 1/2 + 6 2/3 = _____

9. Multiply 32 cents by 485 and write in dollar notation.

   _____

DIVIDE

10. $38\overline{)462}$

UNIT 4 QUIZ

Directions: Calculate the following problems and place your answers on the paper provided.

ADD

1. 3 2/3
   4 1/4
   +5 1/2

2. 8 X 2 2/3 = _____

3. CONVERT

   33 quarts = _____ gallons _____ quarts

   3 gallons = _____ quarts

   1 year = _____ weeks

4. Multiply 27 cents by 618 and express in dollar notation.

   _____

5 Divide $57\overline{)8601}$ and round to the hundredths decimal place.

   _____

6. If the manufacturer recommends you change your oil every 3 months or 3 thousand miles; how many times per year should you change your oil if you drive 1800 miles each month? (show your work)

USE THE FOLLOWING INFORMATION FOR # 7 - 9.

Records indicate that your business did an average of two oil changes per day last year. The average oil change produces 4 1/4 quarts of drain oil. Using 365 as the number of days in a year.....

7. How many quarts of drain oil did your garage produce last year?

   _____

8. The waste oil company will come each time you accumulate 100 gallons of waste oil. How many times during the year did the waste oil company need to come?

_____

9. How much did it cost to have the oil removed for one year if the waste oil company charged you 34 cents per gallon?

_____

10. A customer drives their car 27,000 miles in one year. They change the oil every 3000 miles. If oil costs $1.69 per quart and each oil change requires 3 quarts of oil to complete, what is the cost for the oil for 1 year?

_____

UNIT 5 WORKSHEET

Directions: Compute the following problems. Place all your answers in the space provided. Round to whole percentages.

CONVERT TO PERCENTAGES:

1. 2 out of 4 _____ %

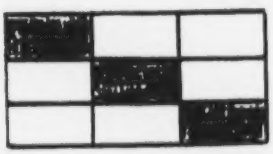
2. 3 out of 7 _____ %

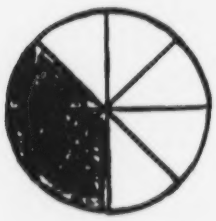
3. 12/35 = _____ %

4. 10% of what number is 4? _____

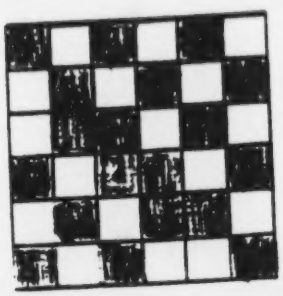
5. 25% of 16 is what number? _____

6. 62 is what percent of 248? _____

7.  What percent is shaded? _____

8.  What percent is shaded? _____

9. What percent is shaded? _____

10.  What percent is shaded? _____

UNIT 5 QUIZ

Directions: Convert to a percentage: (round to 2 decimal places if necessary)

1. 7 out of 9 = _____ %

2. 9/12 = _____ %

3. 14% of what number is 2.8? _____

4. What percent is shaded? _____ %

5. What percent is shaded? _____ %

6. Each cylinder in a four cylinder engine represents what % of the total engine cylinders?

_____ %

7. 75% of the cylinders in a 8 cylinder engine were found to be faulty. How many cylinders were faulty?

_____ cylinders

8. If 3 of the cylinders in a 8 cylinder engine were found to be faulty what % of the cylinders are faulty?

_____ %

9. Two vehicles come to your garage each have faulty cylinders. The first, a 6 cylinder, has 2 faulty cylinders the second, a 4 cylinder, has 1 faulty cylinder. Which engine has the higher % of faulty cylinders? (show all work)

_____

10. A 4 cylinder car with 2 faulty cylinders gets 1 of its cylinders repaired. What percent of the damaged gets repaired?

_____

UNIT 6 WORKSHEET

Directions: Compute the following problems. Reduce answers if possible and place in the space provided.

USE THE FOLLOWING INFORMATION FOR # 1 - 5

A car dealer has 4 red, 3 green, 8 purple, 1 black, and 2 blue cars on the lot.....

1. What fractional part of the total lot is the purple cars?

_____

2. What fractional part of the total lot is the green cars?

_____

3. By combining the red and green cars, what fractional part of all the cars does this represent?

_____

4. If all but the black car are considered 1 group, what fractional part of all the cars does this represent?

_____

5. What fractional part of the total cars on the lot is the collection of cars with even numbered amounts?

_____

6. Express 11 out of 121 as a reduced fraction.

_____

7. Express 9 out of 9 as a reduced fraction.

_____

8. A box of twelve spark plugs contained two different sizes of spark plugs. One third of the spark plugs were type A. How many were type B?

_____

9. Two different kinds of hex wrenches were combined to form a collection of twenty five wrenches. Ten of the wrenches were small sizes. Express as a reduced fraction the number of larger type of wrenches out of the total number of wrenches.

---

10. 5 out of 6 cars on the dealers lot have 4 cylinder engines. Express in words what this statement means.

UNIT 6 QUIZ

Directions: Calculate the following and place your answer in the space provided. Reduce answer if possible.

USE THE FOLLOWING INFORMATION FOR # 1 - 5

A car dealers lot contains 9 white, 7 blue, 5 red and 3 yellow cars.

1. What fractional part of the total lot is the collection of blue cars?

_____

2. If red and yellow cars were combined into one group what fractional part of the total number of cars would they represent?

_____

3. If the red and blue cars were combined what fractional part of all the cars does this represent?

_____

4. What fractional part of the total lot is the collection of white cars?

_____

5. Express as a reduced fraction 34 out of 51 _____ .

6. If half of all the spark plugs in an 8 cylinder engine were carbon fouled, this could be expressed as _____ out of every _____ plugs would be carbon fouled.

USE THE FOLLOWING INFORMATION FOR # 7 - 10

While removing the spark plugs from a 12 cylinder engine a mechanic found that 4 plugs were carbon fouled, 6 plugs were oil fouled and two plugs had detonation damage.

In fractional terms answer the following:

7. What fractional part of the engine's spark plugs was carbon fouled?

_____

8. What fractional part of the engine's spark plugs was oil fouled?

_____

9. What fractional part of the engine's spark plugs was damaged by detonation?

_____

10. What fractional part of the engine's spark plugs was not damaged by detonation?

_____

UNIT 7 WORKSHEET

Directions: Compute the following problems and place in the space provided.

1. CONVERT THE FOLLOWING % TO DECIMALS

PERCENT	DECIMAL EQUIVALENT
a. 8%	_____
b. 2.4%	_____
c. 185%	_____
d. .03%	_____
e. 47%	_____

2. Find 62% of 50 _____

3. 13% of 92 is _____

4. 4.6% of 75 is _____

5. 120% of 238 is _____

ADD

6. 14 3/4 + 11 2/4 = _____

7. 6 1/2 + 4 1/3 + 8 3/4 = _____

8. CONVERT THE FOLLOWING

a. 16 gallons = _____ quarts

b. 102 quarts = _____ gallons _____ quarts

c. 8 gallons = _____ quarts

d. 40 quarts = _____ gallons _____ quarts

e. 3 liters = _____ ml

f. 82 liters = _____ ml

g. 1043 ml = _____ liters

h. 64 ml = _____ liters

USE THE FOLLOWING CHART TO DETERMINE HOW MUCH ANTIFREEZE IS REQUIRED TO PROVIDE PROTECTION TO -34 F. FOR THE COOLING SYSTEM CAPACITIES LISTED (#9 - 12)

QUARTS OF ETHYLENE GLYCOL REQUIRED FOR PROTECTION TO TEMPERATURES SHOWN

Cooling System Capacity Quarts	Number of Quarts of ETHYLENE GLYCOL Required for Protection													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10	+24°F.	+16°F.	+ 4°F.	-12°F.	-34°F.	-62°F.								
11	+25	+18	+ 8	- 6	-23	-47								
12	+26	+19	+10	0	-15	-34	-57°F.							
13	+27	+21	+13	+ 3	- 9	-25	-46							
14			+15	+ 6	- 5	-18	-34							
15			+16	+ 8	0	-12	-26							
16			+17	+10	+ 2	- 8	-19	-34°F.	-52°F.					
17			+18	+12	+ 5	- 4	-14	-27	-42					
18			+19	+14	+ 7	0	-10	-21	-34	-50°F.				
19			+20	+15	+ 9	+ 2	- 7	-16	-28	-42				
20				+16	+10	+ 4	- 3	-12	-22	-34	-48°F.			
21				+17	+12	+ 6	0	- 9	-17	-28	-41			
22				+18	+13	+ 8	+ 2	- 6	-14	-23	-34	-47°F.		
23				+19	+14	+ 9	+ 4	- 3	-10	-19	-29	-40		
24				+19	+15	+10	+ 5	0	- 8	-15	-23	-34	-46°F.	
25				+20	+16	+12	+ 7	+ 1	- 5	-12	-20	-29	-40	-50°F.
26					+17	+13	+ 8	+ 3	- 3	- 9	-16	-25	-34	-44
27					+18	+14	+ 9	+ 5	- 1	- 7	-13	-21	-29	-39
28					+18	+15	+10	+ 6	+ 1	- 5	-11	-18	-25	-34
29					+19	+16	+12	+ 7	+ 2	- 3	- 8	-15	-22	-29
30					+20	+17	+13	+ 8	+ 4	- 1	- 6	-12	-18	-25

9. A car with a 14 quart capacity cooling system enters your garage to have the cooling system flushed. How much anti freeze will be needed to complete the job?

_____ gallons _____ quarts

10. Which job would require more antifreeze to complete?

Job 1. 3 cars each with a 12 quart capacity

Job 2. 2 cars each with a 19 quart capacity

Answer _____

How many quarts of antifreeze would be required to complete both jobs? How many gallons?

Answer _____ quarts

_____ gallons

GIVEN THE SYSTEM CAPACITY FIND THE AMOUNT OF ANTIFREEZE NEEDED TO PROTECT THE SYSTEM TO - 34 F

	System Capacity	Antifreeze required
11.	24 quarts	_____ gallons _____ quarts
12.	18 quarts	_____ gallons _____ quarts

UNIT 7 QUIZ

Directions: Calculate the following and place your answer in the space provided.

1. Find 20% of 87 _____

2. 93% of 33 is _____

ADD

3. 6 1/4 + 8 1/2 + 3 2/4 = _____

4. Using the chart below, how much antifreeze is recommended for a car with a cooling system capacity of 17 quarts? (-34 degrees F)

_____ gallons _____ quarts

QUARTS OF ETHYLENE GLYCOL REQUIRED FOR PROTECTION TO TEMPERATURES SHOWN

Cooling System Capacity Quarts	Number of Quarts of ETHYLENE GLYCOL Required for Protection													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10	+24°F.	+16°F.	+ 4°F.	-12°F.	-34°F.	-62°F.								
11	+25	+18	+ 8	- 6	-23	-47								
12	+26	+19	+10	0	-15	-34	-57°F.							
13	+27	+21	+13	+ 3	- 9	-25	-45							
14			+15	+ 6	- 5	-18	-34							
15			+16	+ 8	0	-12	-26							
16			+17	+10	+ 2	- 8	-19	-34°F.	-52°F.					
17			+18	+12	+ 5	- 4	-14	-27	-42					
18			+19	+14	+ 7	0	-10	-21	-34	-50°F.				
19			+20	+15	+ 9	+ 2	- 7	-18	-28	-42				
20				+16	+10	+ 4	- 3	-12	-22	-34	-48°F.			
21				+17	+12	+ 6	0	- 9	-17	-28	-41			
22				+18	+13	+ 8	+ 2	- 6	-14	-23	-34	-47°F.		
23				+19	+14	+ 9	+ 4	- 3	-10	-19	-29	-40		
24				+19	+15	+10	+ 5	0	- 8	-15	-23	-34	-46°F.	
25				+20	+16	+12	+ 7	+ 1	- 5	-12	-20	-29	-40	-50°F.
26					+17	+13	+ 8	+ 3	- 3	- 9	-16	-25	-34	-44
27					+18	+14	+ 9	+ 5	- 1	- 7	-13	-21	-29	-39
28					+18	+15	+10	+ 6	+ 1	- 5	-11	-18	-25	-34
29					+19	+16	+12	+ 7	+ 2	- 3	- 8	-15	-22	-29
30					+20	+17	+13	+ 8	+ 4	- 1	- 6	-12	-18	-25

NOTE: +32° is freezing. For capacities under 10 quarts multiply true capacity by 3, find quarts of anti-freeze for the tripled volume, divide by 3 for the number of quarts to add. For capacities over 30 quarts divide true capacity by 3, finds quarts of anti-freeze for the ⅓ of volume, multiply by 3 for the number of quarts to add.

CONVERT THE FOLLOWING

5. 6 gallons = _____ quarts

   14 quarts = _____ gallons

   6 liters = _____ ML

   5400 ML = _____ liters

6. If a manufacturer recommended a solution of water and antifreeze that required 60% antifreeze, what percent would be water?

   _____

7. The car you are servicing has a cooling system capacity of 19 quarts. How many quarts of antifreeze will you need to refill the system after it has been drained?

   _____

8. If three cars were scheduled to be winterized how much antifreeze would you need for all three jobs if the first car had a 12 quart capacity, the second a 14 1/2 quart capacity and the third a 17 3/4 quart capacity?

   _____ gallons _____ quarts

9. A car with a 14 quart capacity cooling system enters your garage to have the cooling system flushed. How much antifreeze will be needed to complete the job?

   _____ gallons _____ quarts

10. Which job would require more antifreeze to complete?

    Job 1. 3 cars each with a 12 quart capacity

    Job 2. 2 cars each with a 19 quart capacity

    Answer _____

    How many quarts of antifreeze would be required to complete both jobs? How many gallons?

    Answer _____ quarts

    _____ gallons

UNIT 8 WORKSHEET

Directions: Using the formulas provided calculate the value of the missing variable in the following problems. Place your answer in the space provided.

FORMULAS

E = I X R I = E/R R = E/I

COMPUTE THE FOLLOWING

1.	E = 12	I = 5	R = _____
2.	E = 6	R = 1200	I = _____
3.	I = .02	R = 2400	E = _____
4.	E = 12	R = 150	I = _____
5.	E = 36	I = 2	R = _____
6.	R = 1500	I = .08	E = _____
7.	R = 900	E = 6	I = _____
8.	I = .06	E = .5	R = _____
9.	R = 700	I = .04	E = _____
10.	I = 4	E = 24	R = _____

UNIT 8 QUIZ

Directions: For questions #1 - 5 use the following formulas to solve the problems below. Be sure to show all work and label your answers.

FORMULAS

E = I X R I = E/R R = E/I

E = Volts (volts) I = Current (amps) R = resistance (ohms)

1.	4 volts	.12 amps	R = _____
2.	3.5 amps	200 ohms	E = _____
3.	2000 ohms	15 volts	I = _____
4.	2 volts	.10 amps	R = _____
5.	1.5 amps	500 ohms	E = _____

6. How much current will a light bulb with 10K (10,000) ohms draw when connected to a 36 volt battery?

_____

7. How many volts are being applied to a circuit which is reading .002 amps if the resistance is equal to 3000 ohms?

_____

8. A mechanic is testing a vehicle component that has a 9 volt battery. The circuit has a measured resistance of 10 ohms. How many amps are there in this circuit?

_____

9. During a battery draw test a mechanic obtains a reading of 250 amps. The starters resistance measures 1000 ohms. What is the battery voltage of this vehicle?

_____

10. A car equipped with a 12 volt battery gives you a reading of 2 amps while testing the wiper circuit. What is the resistance in the wiper motor?

_____

UNIT 9 WORKSHEET

Directions: Round the following to two decimal places.

1. 2/16 of 80 = _____

2. 5/7 of 77 = _____

3. 3/4 of 100 = _____

4. 11/13 of 169 = _____

5. 7/8 of 25 = _____

6. 6/7 of 83 = _____

7. 9/15 of 75 = _____

8. 3/5 of 60 = _____

9. 4/11 of 23 = _____

10. 19/20 of 2400 = _____

UNIT 9 QUIZ

Directions: Calculate the following. (round to two decimal places if necessary)

1. 1/2 of 43 = _____

2. 3/5 of 35 = _____

3. 7/11 of 100 = _____

4. 2/9 of 17 = _____

5. 3/4 of 73 = _____

USE THE FOLLOWING INFORMATION FOR QUESTIONS # 6 - 10

Before testing an alternator a mechanic reads the following: "During this test alternator output should not be less than 3/4's of the total rated alternator output."

6. If the alternators rated output is 75 amps, what is the minimum value that will be acceptable for output?

_____

7. If the alternators rated output is 120 amps, what is the minimum value that will be acceptable for output?

_____

8. If the alternators rated output is 90 amps, what is the minimum value that will be acceptable for output?

_____

9. If the alternator rated output is 80 amps, would 75 be an acceptable output? (show all work)

_____

10. If the alternator rated output is 120 amps, would 85 be an acceptable output? (show all work)

_____

UNIT 10 WORKSHEET

Directions: Determine the following: (reduce answers if possible to two decimal places)

1. Ratio of 6 to 8 _____

2. Ratio of 12 to 156 _____

3. Ratio of 21 to 72 _____

USE THE FOLLOWING INFORMATION FOR QUESTIONS #4 - 8

A car dealers lot has a total of 9 Chevrolets and 4 Fords.

4. What is the ratio of Chevys to Fords? _____ to _____

5. What is the ratio of Fords to Chevys? _____ to _____

6. What is the ratio of Chevys to the total cars on the lot?

_____ to _____

7. What is the ratio of Fords to the total cars on the lot?

_____ to _____

8. What is the ratio of the sum of the Fords and Chevys to the total cars on the lot?

_____ to _____

USE THE FOLLOWING INFORMATION FOR QUESTIONS #9 - 10

A wrench set contains 8 metric and 12 standard wrenches.

9. What is the ratio of standard wrenches to metric wrenches?

_____ to _____

10. What is the ratio of the total set of wrenches to non-metric wrenches?

_____ to _____

UNIT 10 QUIZ

Directions: Determine the following ratios: (reduce answers if possible)

1. 12 to 16 = ____ to ____

2. 25 to 180 = ____ to ____

3. 110 to 15 = ____ to ____

4. 7 to 72 = ____ to ____

5. 36 to 48 = ____ to ____

6. A cars ring gear has 80 teeth and the pinion gear has 8. What is the ratio of this rear axle?

_____ to _____

7. Each rotation of the cars driveshaft causes the vehicles tire to rotate 1/4 turn. What is the ratio between the driveshsft and the tire?

_____ to _____

8. A transmission input shaft rotates 1/2 turn causing the output shaft to rotate 1 time. What is the ratio between the input and output shafts?

_____ to _____

9. To paint a car an autobody man mixes 1 gallon of paint with 1 quart of reducer. What is the ratio of paint to reducer?

_____ to _____

10. A mechanic has 150 bolts. 100 are coarse thread and 50 are fine thread? What is the ratio of coarse to fine thread bolts?

_____ to _____

UNIT 11 WORKSHEET

Directions: Round to two decimal places if necessary

1. $18436.9 - 6908.6$

2. $23004.1 - 7825.8$

3. $6.4\overline{)181.7}$

4. $.18\overline{)346.2}$

5. $5.7\overline{)60.08}$

6. $.116\overline{)970.4}$

7. 237×1.08

8. $718 \times .89$

9. 8652×2.26

10. 549×4.83

UNIT 11 QUIZ

Directions: Calculate: Round to two decimal places if necessary.

1. $\begin{array}{r} 764.3 \\ -587.6 \\ \hline \end{array}$

2. $\begin{array}{r} 6040.1 \\ -1604.6 \\ \hline \end{array}$

3. $5.8\overline{)479.2}$

4. $63\overline{)745.6}$

5. $\begin{array}{r} 672 \\ \times 4.51 \\ \hline \end{array}$

USE THE FOLLOWING INFORMATION FOR QUESTIONS 6 - 10

A customer purchased an automobile with 12,462.3 miles recorded on the odometer. One month later the odometer read 14711.2 miles.

6. How many miles did the new owner drive the first month?

ans. _____

7. If the car consumed 104.6 gallons of gas in that time, what was the car's gas mileage?

ans. _____

8. If gas costs $1.21 per gallon how much did the owner spend on gas during the first month? (round to nearest cent)

ans. _____

9. The next month the owner drove 1846.5 miles and decided to use a higher octane fuel costing $1.34 per gallon. What was the cost of fuel the second month?

ans. _____

10. The owner gets a tune-up which increases the milage by 5 miles per gallon. Assuming the car will be driven the same distance the third month as the second, and the owner will continue to use the more expensive gas, how much money will be saved over the second of driving in the cost of fuel?

ans. _____

UNIT 12 WORKSHEET

Directions: Calculate the following examples. Round to two decimal places if necessary.

1. .980
   -.033

2. 11.600
   -.060

3. 9.560
   -.052

4. .860
   -.015

5. 7.500
   -.034

6. A mechanic is turning a drum that measures 9.553. The manual says the drum may only be turned to 9.560. How much material can be safely removed from this drum?

7. A brake rotor measures .808 inches thick. Discard thickness for this rotor is .815. How much was this rotor turned undersize?

8. A brake lathe cuts on both sides of a rotor. If each cutter is set to .015" what will the total amount of material being removed equal?

9. A mechanic cutting a brake drum removes .008" on the first cut, .006" on the second cut and a final cut of .002. What is the total amount of material removed?

10. A mechanic cutting a brake rotor removes .004" on each side during the first pass and .002" on each side during the final pass. What is the total amount of material removed?

UNIT 12 QUIZ

Directions: Calculate: Round to two decimal places if necessary.

1. $\begin{array}{r} .980 \\ -.014 \\ \hline \end{array}$

2. $\begin{array}{r} 11.600 \\ -.022 \\ \hline \end{array}$

3. $\begin{array}{r} 9.560 \\ -.044 \\ \hline \end{array}$

4. $\begin{array}{r} .860 \\ -.024 \\ \hline \end{array}$

5. $\begin{array}{r} 7.500 \\ -.022 \\ \hline \end{array}$

6. A mechanic is turning a drum that measures 9.512. The manual says the drum may only be turned to 9.560. How much material can be safely remoed from this drum?

7. A brake rotor measures .812 inches thick. Discard thickness for this rotor is .815. How much was this rotor turned undersize?

8. A brake lathe cuts on both sides of a rotor. If each cutter is set to .003" what will the total amount of material being removed equal?

9. A mechanic cutting a brake drum removes .010" on the first cut, .008" on the second cut and a final cut of .004. What is the total amount of material removed?

10. A mechanic cutting a brake rotor removes .006" on each side during the first pass and .003" on each side during the final pass. What is the total amount of material removed?

ANSWER KEY

PG. 7

3. 6/32, 20/32, 16/32, 24/32, 28/32, 14/32, 18/32, 5/32

4. 5/32, 6/32, 14/32, 16/32, 18/32, 20/32, 24/32, 28/32

5. 13

6. 9/16"

PG. 9

1. 337 CID
2. 57 CID
3. 905 CID
4. 471 CID
5. 346 CID
6. 243 CID
7. 340 CID
8. 60 CID
9. 151 CID
10. 101 CID

PG. 13

1. 136 PSI
2. 28.5 PSI
3. 1.5 PSI
4. 30 PSI

PG. 15

2. A. 4 TIMES
   B. 8 TIMES

3. 13 7/12 QTS.

PG. 16

1. A. 6000 MILES
   B. 6 MONTHS

2. A. 3,285 QTS./YR.
   B. 273.75 QTS./YR.
   C. 63.17 QTS./WEEK
   D. $4.41/WEEK
      $19.18/MONTH
      $229.95/YEAR

PG. 17

4. A. 66.66% B. 37.5% C. 50%

PG. 18

1. 20%

2. 25%

3. 2 CYLINDERS

4. A. 60%
   B. 40%

PG. 21

1. 1/4 2. 5/12 3. 1/3

PG. 22

1. 130 DEGREES
2. RING AND VALVE STICKING
3. .0005 IN.
4. 35 GPH
   2100 GALLONS
5. 26 HP
6. 32 DEGREES
7. .008 IN.
8. 29 HP
9. 38 GPH
   2280 GALLONS
10. 130 DEGREES

PG. 25

2. 9.5 QTS.

3. 14.75 QTS.

PG. 27

1. 600 OHMS
2. .005 AMPS
3. 750 VOLTS
4. 200 OHMS
5. .005 AMPS
6. 18,000 OHMS
7. .004 AMPS
8. 132 VOLTS
9. .25 OHMS
10. .0033 AMPS

PG. 28

11. 4 AMPS
12. 48,000 VOLTS
13. 300 OHMS
14. .001 AMPS
15. 18 VOLTS
16. 1200 OHMS
17. 4800 AMPS
18. 1500 VOLTS
19. 300 OHMS
20. .01 AMPS

PG. 30

1. 40 AMPS
2. 66 2/3 AMPS
3. 33 1/3 AMPS

PG. 38

1. .025 IN.
2. .037 IN.
3. 11 IN.
4. .032 IN.

PG. 42

1. 1650
2. 2334
3. 702
4. 12288
5. 211,593
6. 132,430
7. 26.958
   26.96
8. 189.182
   189.18
9. 220.359
   220.36
10. 30 INCHES
    8 FT. 6 IN.
    .64 CM
    14.72 METERS
    2.54 CM

PG. 44

1. 606
2. 9958
3. 38,012
4. 175.552
   175.55
5. 56 IN.
   25 FT. 3 IN.
   .62 M
   1000 CM
   2.54 CM
6. 85.666 OR 85'8"
7. 457.5 SQ. FT.
8. 4647.43 CU. FT.
9. 5 GALLONS
10. 3.1 MIN OR 3 MIN 6 SEC.

PG. 45

1. 2 3/16"
2. MEASURE
3. 3/12, 6/12, 8/12
4. 6/20, 7/20, 8/20, 10/20
5. 6/32, 8/32, 10/32, 16/32, 17/32
6. 8/12 = 2/3
7. 7/8
8. 19/12 = 1 7/12
9. 58/60 = 29/30
10. 4/16, 5/16, 6/16, 7/16

PG. 46

1. 1 5/16"
2. MEASURE
3. 15/32
4. 8/11
5. 49/60
6. 2/32, 12/32, 14/32, 16/32
7. 5/20, 6/20, 8/20, 16/20
8. 8
9. 13/16"
10. 1/4", 5/16" - 1/2"

PG. 47

1. 1.764	2. 2.2715	3. 435.08
4. 23.12236	5. 1963.52	6. 137.43
7. 7.01	8. 62	9. 22.96
10. 86.32		

PG. 48

1. 418.11	2. 116.388	3. 11.722
4. 6	5. 6.72	6. 157.25
7. 27.75	8. 7.25	9. .85 X 165 = 140.25 YES

10. A. 148 CID
    B. 511 CID

PG. 49

1. 8 5/16
2. 5 7/8
3. A. 16 QTS.
   B. 4 GALLONS 2 QTS.
   C. 365 DAYS
   D. 52 WEEKS
   E. 12 MONTHS
4. 10 1/2
5. 21 5/7
6. 5 1/3
7. 8 1/2
8. 12 11/12
9. $155.20
10. 12.16

PG. 50

1. 13 5/12

2. 21 1/3

3. 8 GALLONS 1 QT.
12 QTS.
52 WEEKS

4. $166.86

5. 150.89

6. 7 TIMES

7. 3102.5 QTS.

PG. 51

8. 7 TIMES

9. $238.00

10. 9 OIL CHANGES
27 QTS OIL REQ.
$45.63

PG. 52

1. 50%	2. 43%	3. 34%	4. 40	5. 4
6. 25%	7. 33%	8. 37.5%	9. 70%	10. 53%

PG. 53

1. 78%	2. 75%	3. 20%	4. 75%	5. 50%
6. 25%	7. 6 CYLS.	8. 38%	9. 25%	10. 50%

PG. 54

1. 4/9	2. 3/18	3. 7/18	4. 17/18	5. 7/9
6. 1/11	7. 1	8. 2/3 OF 12	8, TYPE B	

PG. 55

9. 3/5

10. FOR EVERY 6 CARS THE DEALER HAS ON THE LOT, ONLY ONE CARS DOES NOT HAVE 4 CYLINDERS.

PG. 56

1. 7/24	2. 1/3	3. 1/2	4. 3/8
5. 2/3	6. 1, 2		

PG. 57

7. 1/3 8. 1/2 9. 1/6 10. 5/6

PG.58

1. A. .08
B. .024
C. 1.85
D. .0003
E. .47

2. 31 3. 11.96 4. 3.45

5. 285.6 6. 26 1/4 7. 19 7/12

8. A. 64 QTS.
B. 25 GALLONS, 2 QTS.
C. 32 QTS.
D. 4 GALLONS, 0 QTS.
E. 3000 ML
F. 82000 ML
G. 1.043 LITERS
H. .064 LITERS

PG. 59

9. 1 GALLON, 3 QTS.

10. JOB 2
74 QTS.

11. 3 GAL., 0 QTS.

18.5 GAL.

12. 2 GAL., 1 QT.

PG. 60

1. 17.4%

2. 30.69

3. 18 1/4

4. 8.5 QTS.

PG. 61

5. 24 QTS.
3.5 GAL.
6000 ML
5.4 LITERS

6. 40%

7. 9.5 QTS.

8. 11 GAL 1/4 QT.

9. 1 GAL., 3 QTS.

10. JOB 2
74 QTS.
18.5 GALLONS

PG. 62

1. 2.4 2. .005 3. 48 4. .08 5. 18

6. 120 7. .006 8. 8.3 9. 28 10. 6

PG. 63

1. 33.3	2. 700	3. .0075	4. 20	5. 750.
6. .0036	7. 6	8. .9	9. 250,000	10. 6

PG. 64

1. 10	2. 55	3. 75	4. 143	5. 21.88
6. 71.14	7. 45	8. 36	9. 8.36	10. 2280

PG. 65

1. 21.5	2. 21	3. 63.63	4. 3.78	5. 54.75
6. 56.25	7. 90	8. 67.5	9. 3/4 OF 80 = 60 75>60 YES	
10. 3/4 OF 120 = 90 90>85 NO				

PG. 66

1. 3/4	2. 1/13	3. 7/24	4. 9 TO 4	5. 4 TO 9
6. 9 TO 13	7. 4 TO 13	8. 13 TO 13 1 TO 1	9. 12 TO 8 3 TO 2	10. 20 TO 12 5 TO 3

PG. 67

1. 12 TO 16 3:4	2. 25 TO 180 5:36	3. 110 TO 15 22:3	4. 7 TO 72	5. 36 TO 48 3:4
6. 10 TO 1	7. 1 TO 1/4 4 TO 1	8. 1/2 TO 1 1:2	9. 4 TO 1	10. 100 TO 50 2:1

PG. 68

1. 11,528.3	2. 15,178.3	3. 28.39	4. 1923.33	5. 10.54
6. 8365.52	7. 255.96	8. 639.02	9. 19,553.52	10. 2651.67

PG. 69

1. 176.7	2. 4435.5	3. 82.6[illegible]	4. 11.83	5. 3030.72
6. 2248.9	7. 21.5			

PG. 70

8. $126.57 9. $115.11 10. $21.71

PG. 71

1. .947"	2. 11.54"	3. 9.508"	4. .845"	5. 7.466"
6. .007"	7. .007"	8. .030"	9. .016"	10. .012"

PG. 72

1. .966"	2. 11.578"	3. 9.516"	4. .836"	5. 7.478"
6. .048"	7. .003"	8. .006"	9. .022"	10. .018"